Description of the Invention

Applicant's invention relates to a method for preparing membrane electrode assemblies (MEAs), and in particular to a method of manufacturing a proton-conducting cation-exchange electrolyte membrane for use in a membrane electrode assembly (MEA), in which atmospheric pressure plasma deposition is used to deposit catalysts such as platinum onto a polymer substrate, or a substrate including carbon cloth or carbon particles. The invention has two principal characteristics:

1) The noble metal catalyst is deposited on the membrane by discharge enhanced chemical vapor deposition (DECVD); and

2) The DECVD is carried out at atmospheric pressure, without adding noble gases to the DECVD carrier gas.

REMARKS

Claims 1, 3-9, and 11-16 are pending, and stand finally rejected.

According to MPEP 2143.01, the fact that references can be combined or modified is not sufficient to establish prima facie obviousness, unless the prior art also suggests the desirability of the combination. (MPEP 2143.01)

Response to the Examiner's Response to Applicant's Arguments

1. The Examiner asserts that the Dearnley and Schutze references should be combined since the Schutze reference describes all the problems associated with the vacuum technology of Dearnley. MPEP 2143.01 requires that the proposed modification cannot render the prior art unsatisfactory for its intended use, and cannot change the principle of operation of a reference. As the Examiner points out, the Schutze reference describes all of the disadvantages of using a vacuum method – thus changing the principle of operation of the Dearnley reference. Moreover, the Schutze academic overview relates to transferred arcs, corona discharge, plasma jets and cold

plasma torches – all making use of oxygen atmospheres. The Dearnley reference requires a vacuum. The oxygen atmospheres taught by Schutze would render the Dearnley vacuum process unsatisfactory for its intended use. Both of these references teach the opposite of applicant's inert or reducing environment.

2. Regarding the carrier gas: The Dearnly reference does not teach a carrier gas. The Schutze reference also does not teach carrier gases – as it is focused on oxidative torches rather than on the deposition of a catalyst layer. The Schutze reference does teach the presence of oxygen (or air) in all of the applications explored. Such an oxidative atmosphere would not function in Applicant's claims for the deposition of a catalyst layer. Thus the Schutze teaching of oxygen in each of the applications explored teaches away from Applicant's need for an inert or reducing environment. ([0028] line 6) The Shutze reference also discloses other gas mixtures for plasma discharge, such mercury and a rare gas mixture (1686, col 2, line 17), oxygen and argon (p1687, col 1, lines 2,3), a mixture of argon and hydrogen (p1687, col 2, line 14), a mixture of helium, oxygen and other gases (p1689, col 2, lines 44-45), mixtures of rare gases, He and Ar (page 1691, col 1, line5). It is mentioned in Schutze that there are enough electrons to dissociate agron (p1998, col 1, line 7) and O_2 and N_2 (page 1691, col 2, line 22) but the composition of a full gas stream containing nitrogen is not mentioned, expect perhaps as the "other gases" that are combined with helium and oxygen mentioned above. The hydrogen referred to by the Examiner in the Schutze reference was not found. The nitrogen is not mentioned as forming any part of a stream in the Schutze reference, but only that the energy is high enough to dissociate nitrogen. While the prior art, including Schutze teach the addition of at least some nobel gas to the discharge stream, Applicant surprisingly found that the use of an inert gas in the carrier stream to suppress arcing, as taught in the art, is not needed – and therefore is excluded in Applicant's claim.

3. The "film" taught in the Schutze reference is only a SiO_2 film, rather than the catalyst film claimed by Applicant – which makes sense since the Schutze reference teaches primarily an oxygen stream.
4. The Fornsel reference teaches the use of nitrogen as both the inert and working gas (col 5, lines 11 and 12) for forming free radicals to react a monomer precursor stream to form a polymer coating on a substrate under atmospheric pressure by plasma enhanced chemical vapor deposition. This is a very different process than the deposition of a catalyst layer on a polymer membrane or carbon cloth.
5. The Hulett reference describes a slurry of a finely divided catalyst and a polymer binder in a liquid to glue the catalyst to the MEA. The slurry method is totally unrelated to the discharged enhanced chemical deposition of Applicant's claims, or to the deposition methods in the Schutze or Dearnley methods. Applicant agrees that the Hulett reference is a secondary reference that teaches an MEA can be moved beneath a nozzle, but what is coming out of the nozzle is each case is so different. The Hulett reference fails to correct the deficiencies of the other cited references.
6. The Yasumoto reference is being used as a secondary reference to show a polymer electrode membrane. However, it also fails to correct the deficiencies of the other cited references.
7. The Kamo reference is also a secondary reference that teaches a platinum alloy applied to a carbon powder, which cannot be used for an MEA, and is not applied by a means as in any other reference, and most importantly contains no teaching or suggestion to correct the deficiencies of the other cited references.
8. Finally the Haug reference is used to show that multiple catalyst layers can be produced – by a vacuum sputter mechanism. Since the currently claimed method is neither vacuum, nor a sputter mechanism, the Haug reference contains no teaching or suggestion to correct the deficiencies of the other cited references.

35 U.S.C. §103

Dearnley in view of Schutze and further in view of Fornsel

Claims 1-5 and 11-13 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Dearnaley (US Patent Number 6,159,533) in view of Schutze and further in view of Fornsel (WO 01/32949, US 6,800,336). The references fail to teach or suggest all of Applicant's claim limitations, as amended, thus no *prima facie* case of obviousness is presented. Specifically, the references fail to teach or suggest a method for manufacturing a cation-exchange membrane by DECVD, where the deposition is carried out at atmospheric pressure without adding a noble gas to the DECVD carrier gas, as set forth in Applicant's previous response.

Dearnley in view of Schutze, in view of Fronsel, and further in view of Hulett

Claim 6 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Dearnaley (US Patent Number 6,159,533) in view of Schutze in view of Fornsel (WO 01/32949, US 6,800,336), and further in view of Hulett (US 6,074,692). The Hulett reference is a secondary reference used to describe advancing the membrane beneath the nozzle. The Hulett reference describes an unrelated slurry-coated membrane method, which is very different from a vapor deposition method of forming a coating. In the Dearnaley reference describing a vacuum system, the enclosed area is so small as to prevent moving the membrane – and there is no nozzle. The Hulett reference fails to heal the defects of the cited references, as set forth in Applicant's previous response.

Dearnley in view of Schutze, in view of Fronsel, and further in view of Yasumoto

Claims 7 and 10 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Dearnaley (US Patent Number 6,159,533) in view of Schutze in view of Fornsel (WO 01/32949, US 6,800,336), and further in view of Yasumoto (US 2003/0096154). The Yasumoto is a secondary reference cited by the Examiner to teach the spraying of the catalyst onto the surface of the polymer electrode membrane. The Yasumoto reference fails to heal the defects of the cited references, as set forth in Applicant's previous response.

Dearnley in view of Schutze, in view of Fronsel, in view of Yasumoto, further in view of Nanaumi

Claims 8-9 stand rejected under 35 U.S.C. 103(a) as being unpatebtable over Dearnaley (US Patent Number 6,159,533) in view of Schutze in view of Fornsel (WO 01/32949, US 6,800,336). in view of Yasumoto (US 2003/0096154) and further in view of Nanaumi (US 2004/0180250).

The Nanaumi reference is cited to cite polymer electrolyte membrane structures. However the Nanaumi reference fails to teach or suggest Applicant's many claim limitations, and fails to correct the many deficiencies of the other references cited.

Dearnley in view of Schutze, in view of Fronsel, further in view of Kamo

Claims 14 and 15 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Dearnaley (US Patent Number 6,159,533) in view of Schutze in view of Fornsel (WO 01/32949, US 6,800,336), and further in view of Kamo (US 2003/0059659). The Kamo reference is a secondary reference cited to show the use of a platinum alloy in the anode side of an electrolyte membrane. While the Kamo reference discloses a platinum/ruthenium alloy for a fuel cell electrode, the platinum/ruthenium alloy is supported on a carbon powder, rather than directly on a membrane as claimed by Applicant. The Kamoreference fails to heal the defects of the cited references, as set forth in Applicant's previous response.

Dearnley in view of Schutze and Fronsel, further in view of Haug

Claim 16 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Dearnaley (US Patent Number 6,159,533) in view of Schutze in view of Fornsel (WO 01/32949, US 6,800,336), and further in view of Haug. The Haug reference is a secondary reference cited to show the deposition of multiple catalyst layers. The Haug reference demonstrates the use of a vacuum sputter deposition system for producing a PEM. The disclosure of a multiple layer of catalyst by methods teaching away from

Applicant's claimed method fails to heal the defects of the cited art to present a *prima facie* case of obviousness.

Conclusion

The Examiner has painfully taken many unrelated references from unrelated art area, teaching a multitude of different methods for different purposes. Picking and choosing specific elements from various prior art references to create the claimed invention is not proper §103 analysis. Applicant contends that the obviousness rejection in this case is a classic example of hindsight, in effect using Applicant's claims as a template on which selected bits of prior art teachings can be assembled. This is not a proper basis for rejection of claims. "One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention." *In re Fine*, 5 U.S.P.Q. 1596, 1600 (Fed. Cir. 1988).

Applicant agrees with the Examiner that case law has stated that most if not all inventions arise from a combination of old elements. Thus every element of a claimed invention may often be found in the prior art. However, identification in the prior art of each individual part claimed is insufficient to defeat patentability of the whole claimed invention. Rather, to establish obviousness based on a combination of the elements disclosed in the prior art, there must be some motivation, suggestion or teaching of the desirability of making the specific combination that was made by applicant. *In re Kotzab*, 55 U.S.P. Q.2d 1313, 1316 (Fed. Cir. 2000)(citations omitted). There are more dissimilarities in the cited references than any teaching or suggestion to combine the references.

The references cited, either alone or in combination, fail to teach or suggest all of Applicant's claim limitations, and therefore fail to present a *prima facie* case of obviousness over Applicant's amended claims. For the above reasons the present claims 1-16, as amended, are believed by the Applicant to be novel and unobvious over the prior art. thus the claims herein should be allowable to the Applicant. Applicant has also used this response to set forth arguments that will be used during the Appeal process, and which Applicant believes distinguish the presently claimed invention from the art.

Accordingly, reconsideration and allowance are requested.

Respectfully submitted,

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